

39 Other environmental matters

39.1 Introduction

This chapter considers the impacts of the long term development on environmental matters not included in the preceding chapters. The strategic level assessment builds on the consideration of potential impacts associated with the Stage 1 development.

The detailed design of the long term development would be undertaken in accord with the master planning provisions of the *Airports Act 1996* and would therefore be subject to further assessment and approval requirements.

This chapter provides an overview of the likely scale of potential impacts associated with the long term development, and considerations for future development, with regard to the following issues:

- biodiversity;
- topography, geology and soils;
- Aboriginal heritage;
- European heritage;
- resources and waste;
- hazards and risks; and
- human health.

39.2 Biodiversity

39.2.1 Existing environment

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The airport site features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses are agriculture and low density rural-residential development.

A total of 280 terrestrial plant species, including 28 threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Threatened Species Conservation Act 1995* (TSC Act), and 78 exotic species have been identified or are predicted to occur at the airport site. Field surveys confirmed the presence and distribution of five native vegetation communities and two non-native vegetation communities at the airport site, including local occurrences of one community listed under the EPBC Act and three communities listed under the TSC Act. The condition of these vegetation communities varies and includes near-intact vegetation in 'moderate/good – high' condition, partially cleared or regrowth vegetation in 'moderate/good – poor' condition and extensively modified areas in 'cleared' condition. Vegetation at the airport site is mapped in Figure 39–1.

A total of 173 terrestrial fauna species, including one threatened species listed under the EPBC Act and a further 10 threatened species listed under the TSC Act, and a number of introduced species have been identified at the airport site. Another 28 threatened fauna species were considered likely or possible to occur at the airport site.

39.2.2 Assessment of impacts during construction

Construction of the long term development would result in both direct and indirect impacts on terrestrial and aquatic flora and fauna.

39.2.2.1 Direct impacts

Construction of the long term development would result in the removal of approximately 503 hectares of vegetation on the southern portion of the airport site not included in the environmental conservation zone. The majority of this vegetation—about 409 hectares—consists of exotic grassland, cleared land and cropland dominated by exotic species and noxious and environmental weeds, with the remainder consisting of native grassy woodland and open forest with some farm dams. Vegetation removal by vegetation zone is summarised in Table 39–1.

The removal of vegetation—in addition to the loss of streams, farm dams and associated aquatic habitats—at the airport site would result in the loss of foraging, breeding, roosting, sheltering and/or dispersal habitat for various fauna species.

In principle, land needed for the long term development that supports vegetation and habitats of conservation significance would not be cleared until it is required for future aviation development or other associated uses. Any proposal to clear such land, or any other land, in the interim would be subject to the requirements of the Airports Act and the EPBC Act. This approach means that impacts on biodiversity values would be avoided for as long as is practicable.

Table 39–1 Estimated vegetation removal by vegetation zone for the long term development

Vegetation zone	Conservation status under applicable legislation		Direct impact (hectares)
	EPBC Act status	TSC Act status	
Native vegetation zones			
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	37.5
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)		CEEC	14.2
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	7.3
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)		CEEC	3.4
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	18.6

Vegetation zone	Conservation status under applicable legislation		Direct impact (hectares)
	EPBC Act status	TSC Act status	
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	5.3
Good condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)	CEEC	EEC	0.5
Poor condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)		EEC	0.5
Good condition farm dams on floodplain (HN630)			6.3
Total native vegetation			93.6
Non-native vegetation zones			
Exotic grassland			243.1
Cleared land or cropland			166.3
Total non-native vegetation			409.4
Total vegetation			503.0

CEEC = critically endangered ecological community; EEC = endangered ecological community.

39.2.2.2 Indirect impacts

The long term development at the airport site is expected to result in a similar set of indirect impacts as for the Stage 1 development (see Chapter 16 (Volume 2a)). Potential indirect impacts would include:

- increased fragmentation of native vegetation and habitat in the locality and region;
- weed invasion of adjacent vegetation or aquatic areas, which may reduce habitat quality for native flora and fauna;
- edge effects, which may reduce habitat quality for native flora and fauna in adjacent areas;
- erosion, mobilisation and transportation of sediment, which could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation and aquatic areas downstream;
- generation of dust, which could reduce plant and animal health in adjacent areas of vegetation;
- the risk of habitat degradation from accidental spills of fuel or the mobilisation of contaminants due to earthworks;

- further alterations to the hydrology of catchments (noting that the airport would be designed to avoid adverse changes to hydrology and may result in an overall improvement in water quality);
- generation of noise, light and vibration, resulting in the disturbance of fauna that reside or use habitats near the construction area; and
- potential spread or introduction of pathogens such as Phytophthora, Myrtle Rust and Chytrid fungus into adjacent native vegetation and downstream habitats through vegetation disturbance and increased human traffic.

39.2.3 Assessment of impacts during operation

The long term development would result in a similar set of operational impacts as for the Stage 1 development (see Chapter 16 (Volume 2a)). Potential operational impacts would include:

- increased risk of bird and bat strike with the increased volume of aircraft traffic and associated need to control bird habitat both on and surrounding the airport site;
- the risk of terrestrial fauna mortality through vehicle strike, although the initial operation of the airport and increased development of industrial and commercial areas around the airport site are likely to result in a reduced risk over time, as less habitat is available for these fauna species;
- the risk of habitat degradation from accidental spills of fuel, pesticides, herbicides or transported goods;
- increased noise, light and vibration which may result in the further displacement of less-tolerant species from habitats adjoining the airport site;
- the risk of fires which may spread to adjacent vegetation; and
- the risk of introducing exotic species.

39.2.4 Assessments of significance

This section summarises impacts on matters of national environmental significance (MNES) and on State-listed threatened species, populations and ecological communities from the construction and operation of the long term development.

39.2.4.1 Impacts on matters of national environmental significance

Assessments of significance for MNES have been prepared in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DoE 2013a) and the Significant Impact Guidelines 1.2 – Actions on, or Impacting upon, Commonwealth Land and Actions by Commonwealth Agencies (DoE 2013b). The assessments of significance are included as Appendix D of Appendix K1 (Volume 4). Assessments of significance were prepared based on the assumption that the entire airport site would be developed.

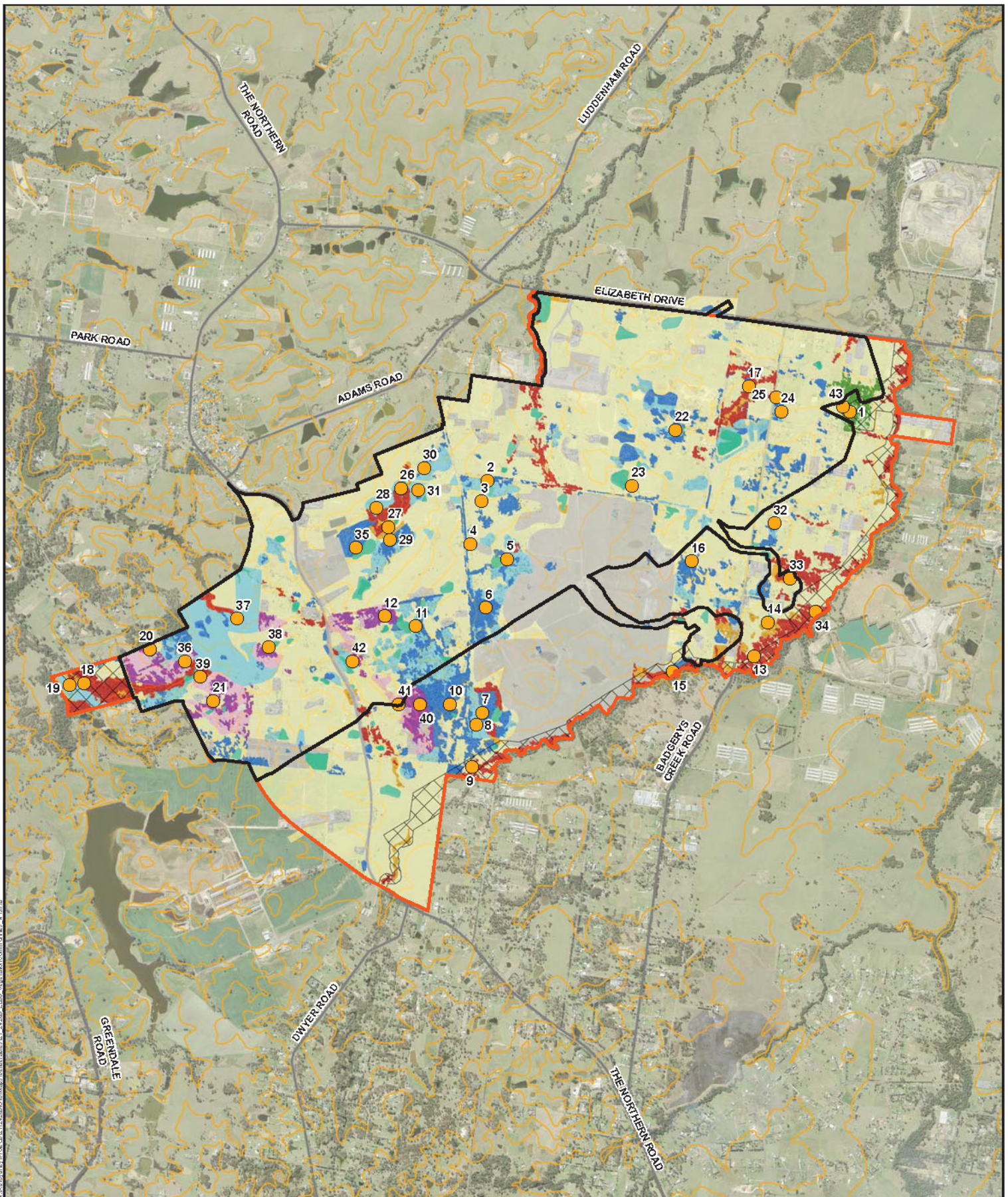
A significant impact was determined for Cumberland Plain Woodland and the Grey-headed Flying-fox. Construction and operation of the long term development would also have a significant impact on plants and animals on Commonwealth land. The key findings of the assessments are summarised in Chapter 16 (Volume 2a).

39.2.4.2 Impacts on State listed threatened species, populations and ecological communities

An assessment of impacts was undertaken for threatened species, populations and ecological communities listed under the TSC Act. A significant impact was determined for one threatened flora population (*Marsdenia viridiflora* subsp. *viridiflora*) and for three threatened ecological communities (Cumberland Plain Woodland, River Flat Eucalypt Forest and Shale-Gravel Transition Forest). In addition, a significant impact was determined for one threatened invertebrate (the Cumberland Plain Land Snail) and four threatened bat species (the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheath-tail-bat). The key findings of the assessment are summarised in Chapter 16 (Volume 2a).

39.2.5 Considerations for future development

Chapter 16 (Volume 2a) sets out the mitigation and management measures that are proposed to address impacts on terrestrial and aquatic flora and fauna for the Stage 1 development, including an offset for the residual impacts to biodiversity values. These measures would also generally apply to the construction and operation of the long term development. Appropriate offsetting would also be required as part of any future approvals for the long term development.



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

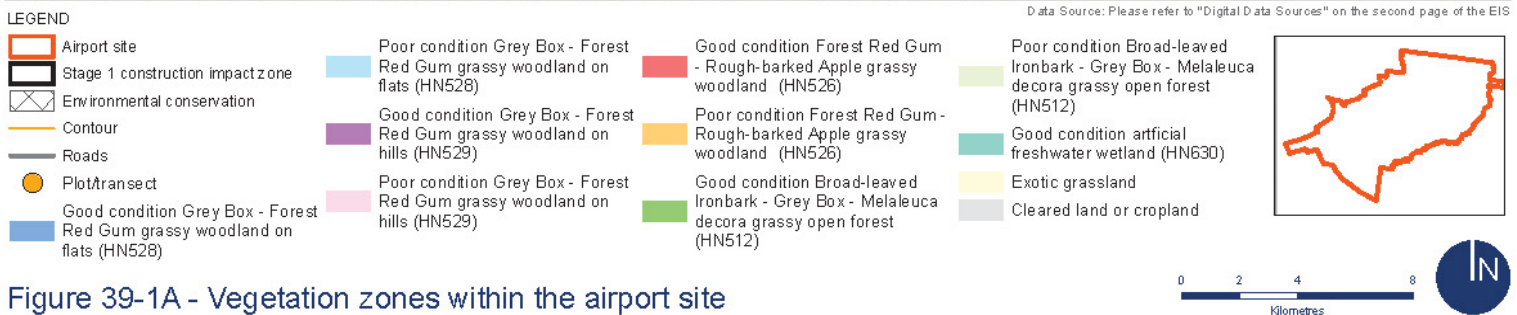
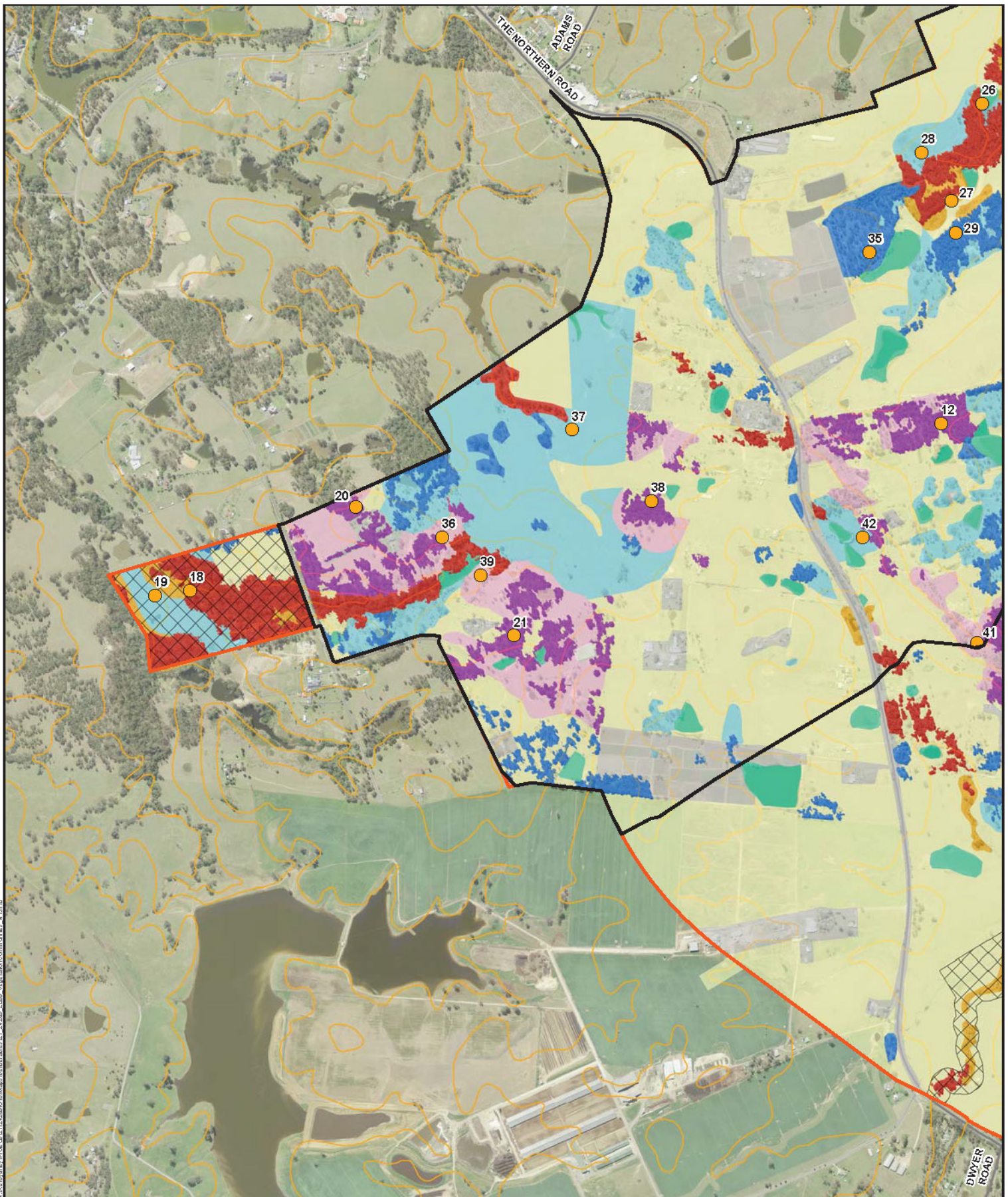


Figure 39-1A - Vegetation zones within the airport site



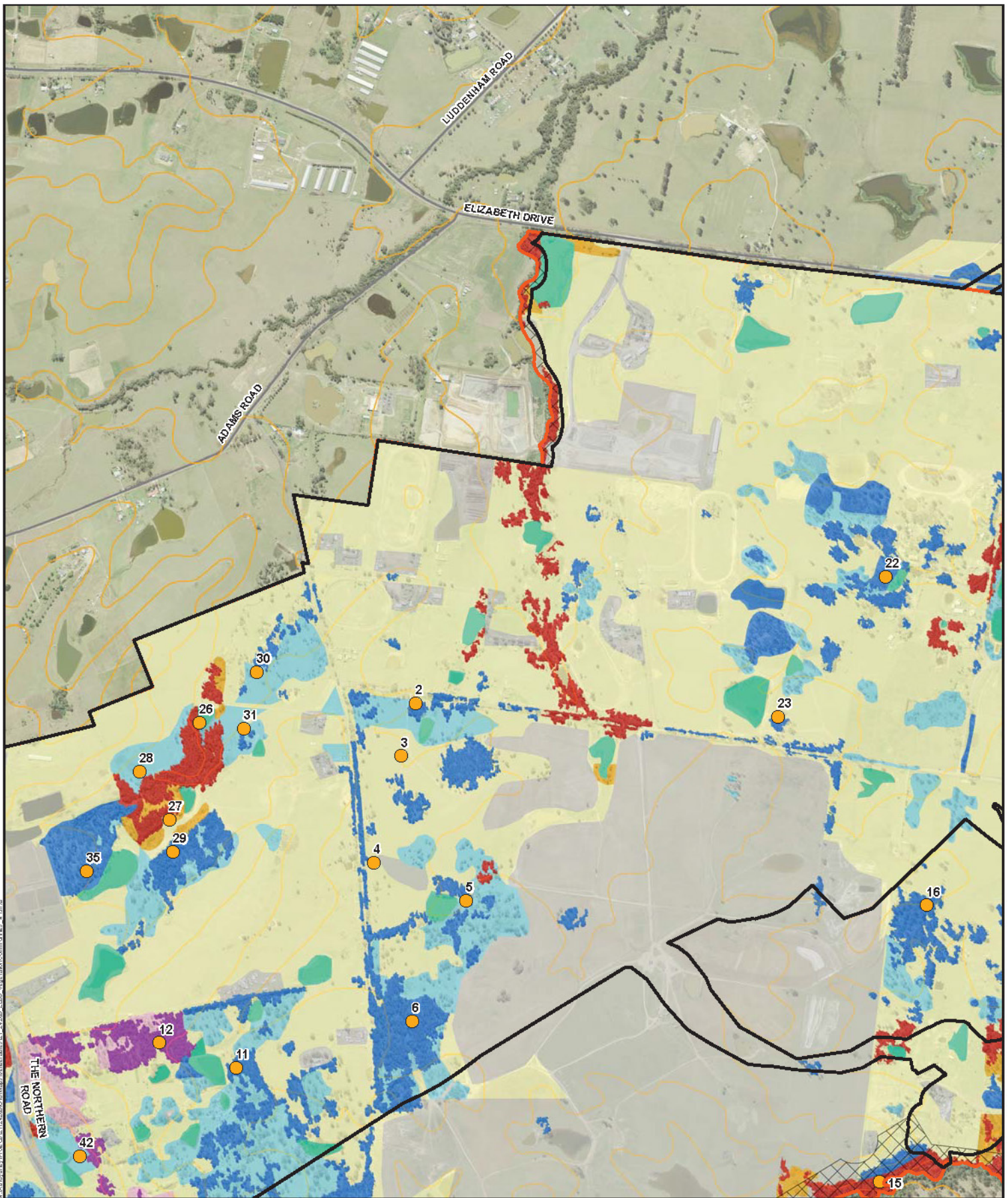
LEGEND

Airport site	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
Stage 1 construction impact zone	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Good condition artificial freshwater wetland (HN630)
Environmental conservation	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	Exotic grassland
Contour			Cleared land or cropland
Roads			
Plot/transect			
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)			

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 39-1B - Vegetation zones within the airport site





LEGEND

Airport site	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
Stage 1 construction impact zone	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Good condition artificial freshwater wetland (HN630)
Environmental conservation	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	Exotic grassland
Contour			Cleared land or cropland
Roads			
Plot transect			
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)			

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

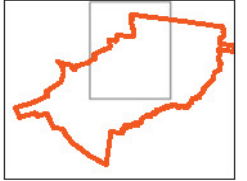


Figure 39-1C - Vegetation zones within the airport site

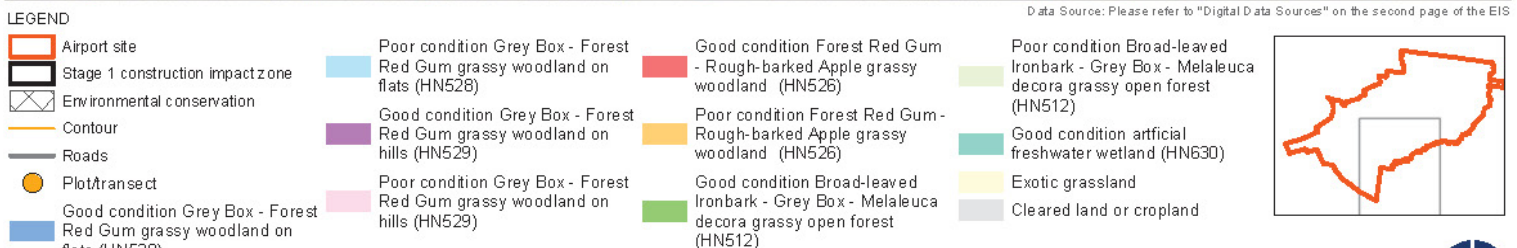
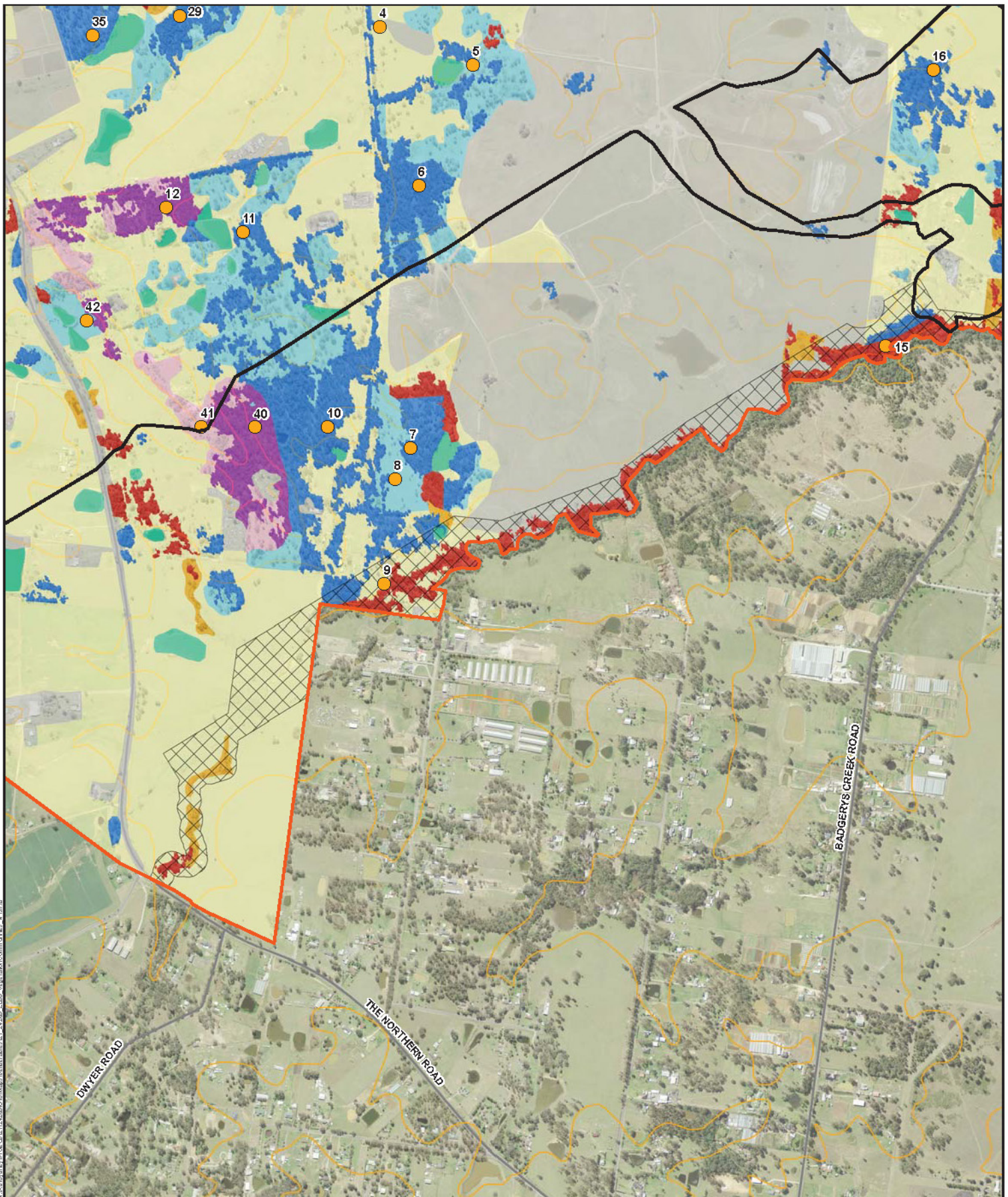
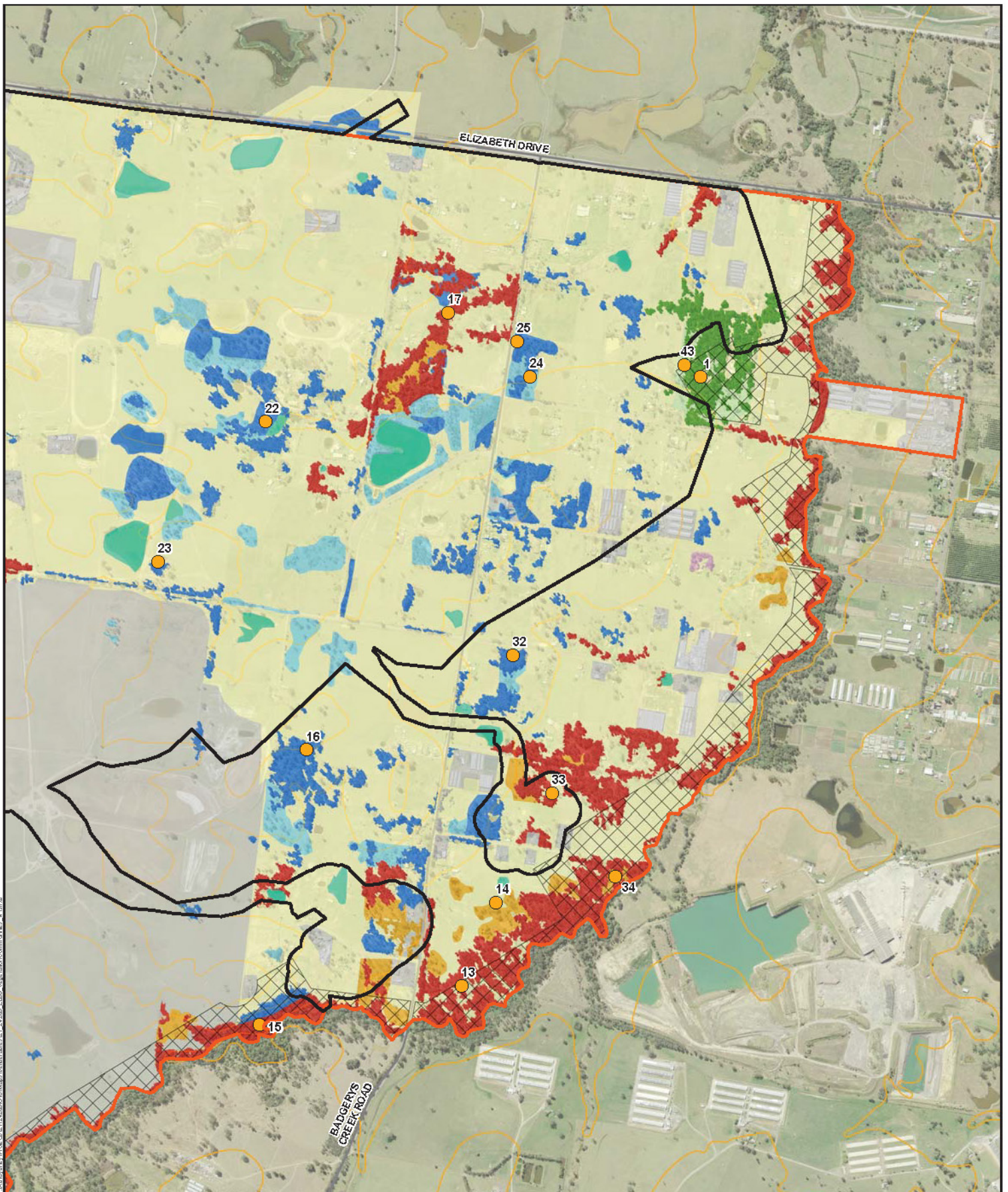


Figure 39-1D - Vegetation zones within the airport site





Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

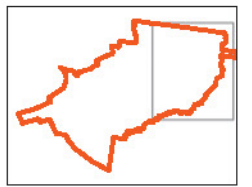
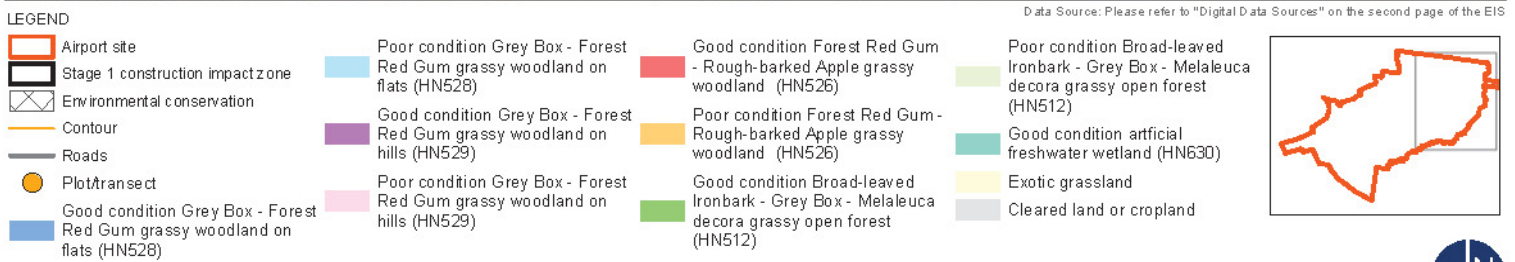


Figure 39-1E - Vegetation zones within the airport site



39.3 Topography, geology and soils

39.3.1 Existing environments

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments. The site is characterised by rolling landscapes with a prominent ridge in the west of the site, reaching an elevation of about 120 metres above Australian Height Datum (AHD), and smaller ridge lines in the vicinity with elevations of about 100 metres AHD. The topography of the airport site generally slopes away from the ridges in the west, at elevations between 40 metres and 90 metres AHD, with the lower elevations occurring toward Badgerys Creek.

The dominant geological formations beneath the airport site are Bringelly Shale, the Luddenham Dyke and alluvium. Bringelly Shale is a Triassic geological unit mainly comprising claystone and siltstone, with some areas of sandstone. Luddenham Dyke is a Jurassic groundmass of olivine basalt, analcite, augite, feldspar and magnetite that outcrops toward the peak of the ridge in the western portion of the airport site (Bannerman and Hazelton 1990). Alluvium at the airport site consists of Quaternary sedimentary deposits along Cosgrove Creek and Badgerys Creek.

Geotechnical investigations at the airport site generally indicated surficial silt and/or clay topsoils overlying firm residual clays from the weathering of Bringelly Shale, with areas of alluvial gravels, sands, silts and clays associated with Badgerys Creek.

The soils at the airport site are categorised as the Blacktown, Luddenham and South Creek soil landscapes, based on consistent soil type, material, depth and erosion characteristics. Soils are anticipated to be moderately saline, with higher potential for salinity along Badgerys Creek and drainage lines in the south and west of the airport site.

Prior activities at the airport site, including agriculture, light commercial and building demolition, mean there is potential for contaminated land to be present at the airport site.

39.3.2 Assessment of impacts

It is expected that a bulk earthworks programme would be undertaken over the southern portion of the airport site. This would provide a level platform for construction of the long term development including the second runway. The bulk earthworks would change the topography of the southern portion of the airport site from a rolling landscape to an approximately level, built environment.

Clearing and bulk earthworks would increase the surface area and, in some instances, the slope of exposed soil at the airport site. These changes to the landscape would present a risk of increased erosion. Erosion may occur in the form of runoff during rainfall or windblown dust. Stockpiled topsoil would also present an erosion hazard and would be subject to potential degradation of chemical and physical fertility over time.

The design of the long term development would incorporate landscaped areas and stormwater drainage including grassed swales and detention basins to control the quantity and quality of stormwater runoff. This drainage system would be functional throughout construction and operation to capture surface runoff prior to discharge to receiving waters. Implementation of standard erosion and sediment control measures during earthworks would minimise impacts in relation to soil erosion and degradation.

Construction of the long term development has the potential to interact with existing sources of potential land contamination. Any contamination discovered during construction would be managed to make the land suitable for its intended use and to prevent impacts on human health and the environment.

Accidental release or mobilisation of contaminants has the potential to affect human health and the environment through contact with pathogens (in the case of sewage), inhalation (in the case of asbestos or chemical vapours), or mobilisation to surface waters or bioaccumulation. These events would be avoided in the first instance through the implementation of applicable Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak or spill of contaminants, remediation would be implemented as soon as practicable.

39.3.3 Considerations for future development

The potential impacts of the construction of the long term development would be typical of a large scale construction project and are expected to be manageable with the implementation of standard stormwater, erosion and dust controls and adherence to industry standards for the storage and handling of chemicals. Other relevant measures to mitigate and manage the potential impacts arising from future development include designing earthworks and final landforms to integrate with the surrounding landscape, with particular emphasis on avoiding steep slopes and ensuring the protection of the environmental conservation zone along Badgerys Creek.

39.4 Aboriginal heritage

39.4.1 Existing environment

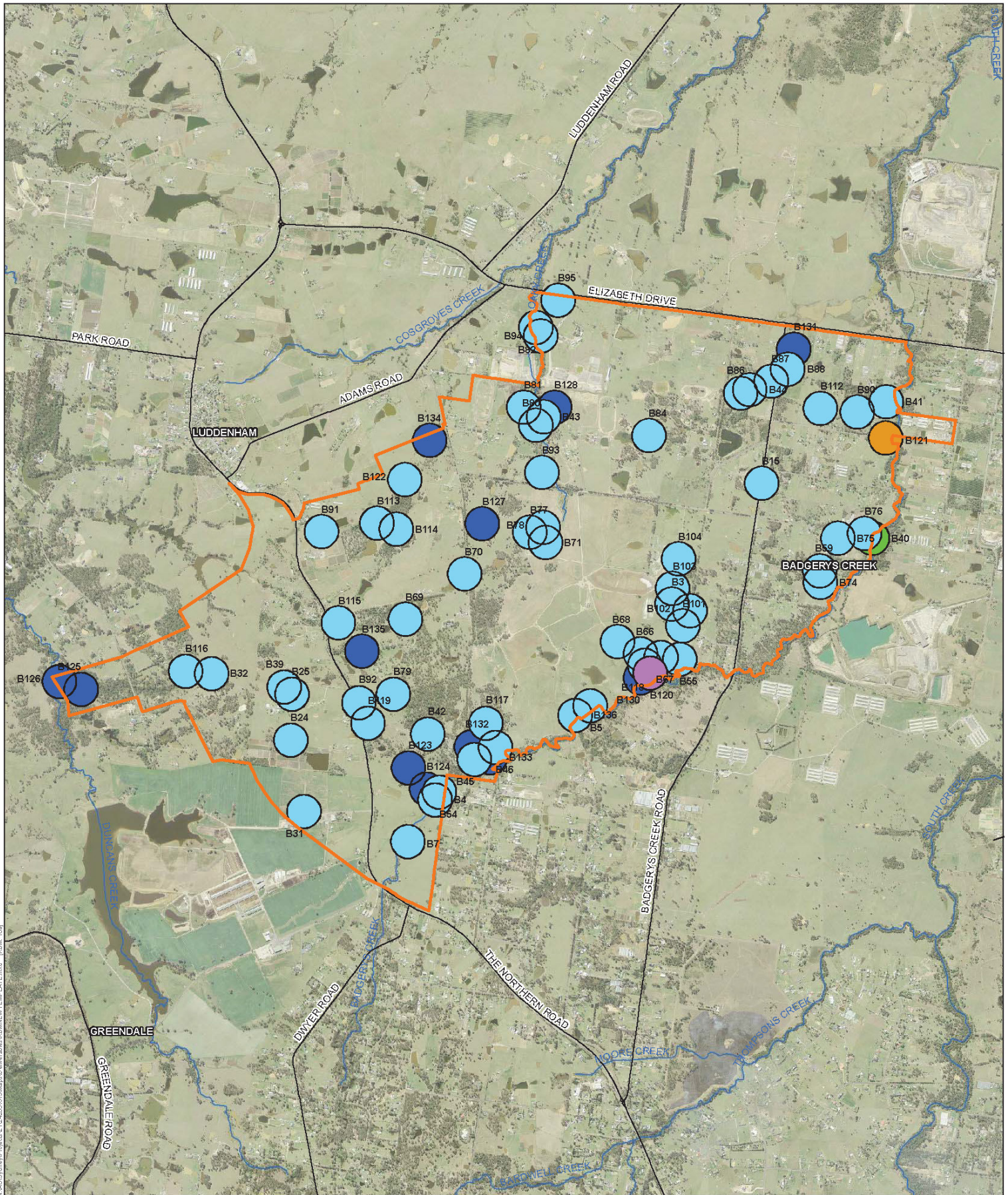
The airport site has been the subject of a number of previous archaeological assessments. Fifty-one Aboriginal heritage sites were recorded during these surveys, consisting of surface artefact occurrences and a modified tree. Twenty-three additional sites were recorded at the airport site during the course of the current assessment, which focused on test excavation and characterising the subsurface archaeological resource.

The new recordings comprised nine sites with surface artefacts (including a grinding groove site) and 14 sites where subsurface artefacts were confirmed through test pit excavations. The locations of all site recordings to date are shown in Figure 39–2.

The test excavation programme included a representative sample of landform types and zones within the airport site. It was determined that a relatively high average artefact incidence occurred across valley floors, basal slopes, first order spurlines and within 100 metres of second, third and fourth order streams.

These findings indicate that Aboriginal heritage sites occur widely across the landscape, but particularly on elevated level ground and slopes within relative proximity of a water source, and that larger sites with higher artefact densities are more likely to be near permanent water.

A more detailed review of the Aboriginal cultural heritage values of the site and surrounding area is provided in Chapter 19 (Volume 2a) and in Appendix M1 (Volume 4).



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 39-2 - Aboriginal heritage at the airport site



39.4.2 Assessment of impacts during construction

Construction of the long term development would affect 23 recorded Aboriginal sites. All of these sites contain artefact occurrences and are listed in Table 39–2.

Eight sites, including the scarred tree (B40) and the grinding groove site (B120), are located within the environmental conservation zone adjacent to Badgerys Creek and would therefore be unaffected by the construction of the long term development.

Table 39–2 Aboriginal heritage sites directly affected by construction of the long term development

Development area or land use zone	Affected surface sites	Total
Impacted by long term development	B3, B5, B31, B42, part B45, part B46, B59, B66, B67, B68, B75, B76, B95, B103, B117, B118, part B121, B123, B124, B125, B126, B132 and B136	23
Situated in environmental conservation zone, including Badgerys Creek	B4, B7, B40, B41, part B45, part B46, B54, B55, B74, B90, B120, part 121, B130, B133 and B135	15

With regard to the predicted subsurface archaeological resource, construction of the long term development would directly affect approximately 374 hectares of archaeologically sensitive landform. This constitutes about 20 per cent of the airport site. These landform categories, and their affected proportions, are presented in Table 39–3.

The long term development of the airport site would directly affect the south-eastern area of the airport site adjacent to Badgerys Creek. Consistent with the Stage 1 development, all of the higher relief and prominent topography of the airport site would be transformed into a level and graded platform. This would alter and remove the natural topography, which acts as a means for Aboriginal people to ‘read’ and experience the Aboriginal cultural values of the land.

Table 39–3 Area and proportion of archaeologically sensitive landforms directly affected by the construction of the long term development

Landform	Extent on airport site (hectares)	Extent affected by long term development (hectares)
Riparian corridor	369.6	108.5
Ridge and spur crests	120.3	51.3
Valley floor	184.0	133.6
Basal slopes	214.2	80.5
Total	888.1	373.9

39.4.3 Assessment of impacts during operation

Impacts during operation of the long term development would be limited to indirect impacts on sites located within the portion of the Badgerys Creek riparian zone within the environmental conservation zone on the airport site, or on lands adjoining the airport site.

The majority of known Aboriginal heritage sites within approximately 500 metres of the construction impact zone of the long term development consist of artefact occurrences. The heritage values of artefact occurrences are unlikely to be vulnerable to indirect impacts such as loss of context.

The scarred tree (B40) and the grinding groove site (B120) are situated close to the airport site boundary fence. Given the value of these sites and potential for public interpretation, the indirect impacts of the adjacent development area on their contextual values are likely to be appreciable.

Potential impacts from the long term airport development on cultural heritage values of the Greater Blue Mountains World Heritage Area (GBMWA) would be indirect in nature and relate to aircraft noise and visual intrusion from aircraft overflights. As discussed in Chapter 38, aircraft would generally be more than 5,000 feet above ground level when passing over the GBMWA and a significant impact on Indigenous cultural heritage values of the area is not expected.

39.4.4 Considerations for future development stages

Chapter 19 (Volume 2a) sets out the mitigation and management measures that are proposed to address impacts on Aboriginal heritage for the Stage 1 development. These measures would also generally apply to the construction and operation of the long term development, subject to future planning and environmental assessments. These measures may include the conservation of heritage sites, recording and salvage of heritage sites, the commemoration of cultural heritage values at the airport site, curation and repatriation of heritage items, and protocols for the discovery of artefacts and human remains.


39.5 European heritage

39.5.1 Existing environment

The assessment of European heritage identified 20 European heritage items at the airport site and associated sites and an additional 22 heritage items in the surrounding area, as shown on Figure 39-3. The identified items are all considered to be generally of local heritage significance.

The identified European heritage items reflect the historical context of the airport site and European settlement more generally, including early attempts to develop local agricultural and pastoral economies and the emergence of settled village communities. These farmlands have continued in rural use and provide insight into early agricultural production.

European settlement around Badgerys Creek began with land grants to settlers in the early nineteenth century for the purpose of establishing large rural estates for agricultural production to feed the colony's growing population. The site was associated with cropping and later vineyards and orchards, and retains an historic association with markets for the supply of meat and livestock to metropolitan Sydney. The emergence of a settled village and farm community at Badgerys Creek in the last half of the nineteenth century is historically associated with the breakup of the large estates for closer settlement. This is demonstrated in street alignments, subdivision patterns, dwellings, churches and cemeteries, community gathering places, recreation grounds, park reserves and places of education.



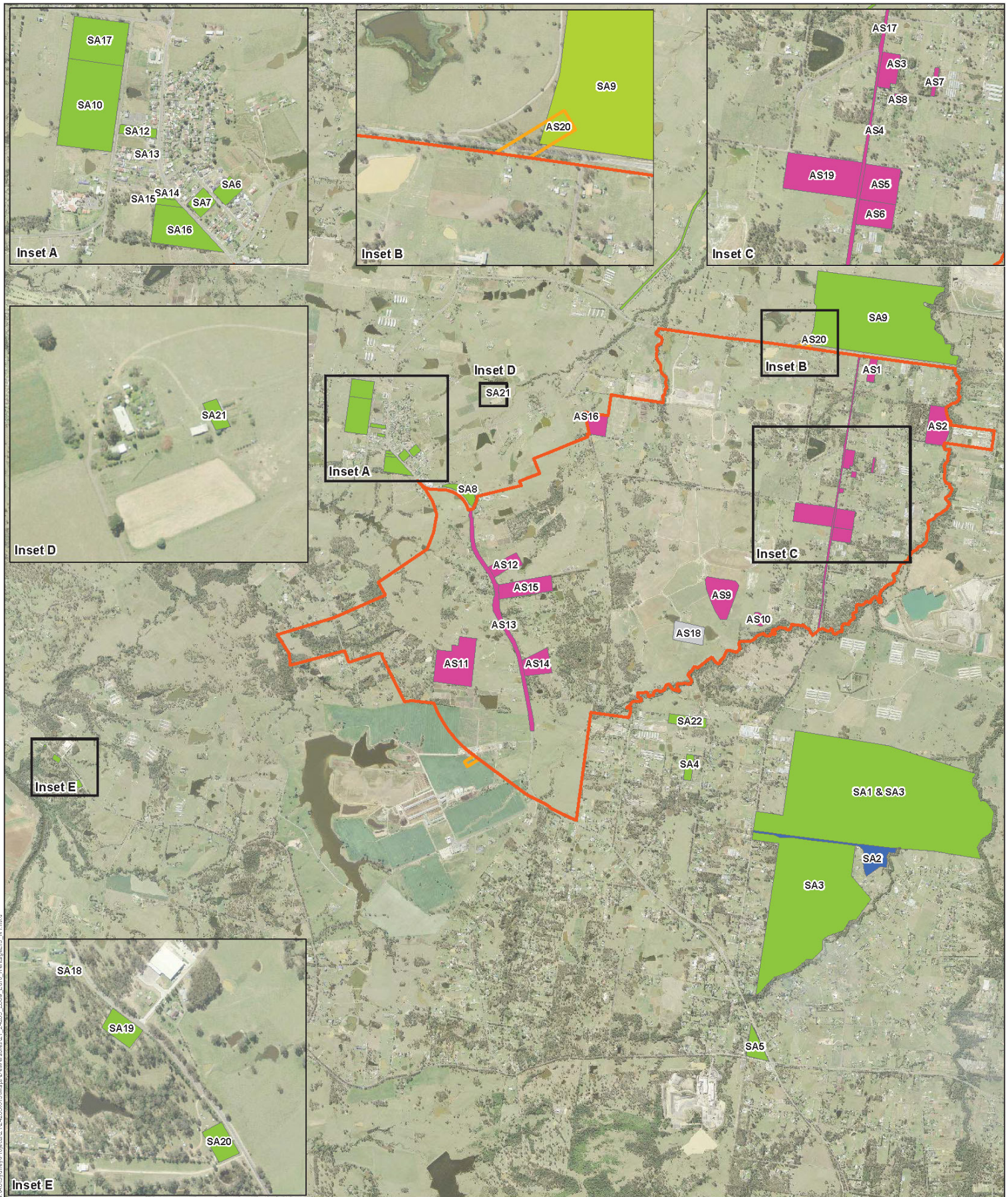
The site includes a public school, which demonstrates the development of public education from the late 1800s. The scale, material and design of the school buildings reflect the evolving fortunes of Badgerys Creek, education reform, the local community and architectural styles.

A more detailed review of the European heritage values of the site and surrounding area is provided in Chapter 20 (Volume 2a) and in Appendix M2 (Volume 4).

39.5.2 Assessment of impacts

Any remaining structures at the airport site would be removed during preparatory activities for the Stage 1 development. The European heritage items identified at the airport site would therefore not be present during the long term development.

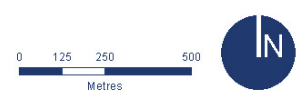
The European heritage items surrounding the airport site would potentially be present during the construction and operation of the long term development. The long term development would not be expected to have a significant impact on the heritage value or conservation significance of these items. While the landscape and views experienced at these places would change, the changes would not materially affect the European heritage values. Similarly, noise from the construction and operation of the long term development would affect the ambience and amenity of these places, but would not be expected to cause material harm to European heritage structures or items.



- LEGEND**
- Airport site
 - HIAL
 - European heritage items**
 - Commonwealth significance
 - Local significance
 - State significance
 - Undetermined significance

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 39-3 - European heritage items within and surrounding the airport site



39.5.3 Considerations for future development stages

A range of measures is proposed to mitigate and manage potential impacts on particular European heritage items at the airport site before site preparation and construction of the Stage 1 development. These measures include archival recording, cultural plantings and exploration of options to relocate structures. The measures to be implemented during Stage 1 are described in more detail in Chapter 20 (Volume 2a).

The potential impacts of the long term development on the European heritage values at the airport site would be negligible, as all potential impacts would be mitigated and managed prior to the construction of the long term development. Alterations to the landscape, views and ambience would not materially affect European heritage items surrounding the airport site.

39.6 Resources and waste

39.6.1 Waste streams

Establishment of the long term development would involve clearing and a major bulk earthworks programme to achieve a level surface suitable for construction of airport facilities in the southern part of the airport site. This would involve the use of a range of construction materials.

As with any large infrastructure project, the construction and operation of the long term development would involve the consumption of natural resources and has the potential to generate significant quantities of waste.

Key waste streams would include waste vegetation from clearing, waste construction materials such as concrete and timber, food waste and other general waste from terminal facilities, and waste oils, paints and cleaners from maintenance activities. The waste streams that would be generated would be similar to those described for the Stage 1 development included in Chapter 25 (Volume 2a).

The volume of resources consumed and waste generated during the construction of the long term development would be similar to the volumes consumed and generated for construction of the Stage 1 development.

The volume of waste generated during operation of the long term development would be substantially greater than during Stage 1 operations. The operational waste volume would increase from about 5,300 tonnes each year during Stage 1, to about 44,000 tonnes each year during operations in the long term.

39.6.2 Considerations for future development stages

As with the management of waste generated by the Stage 1 development, a combination of onsite and offsite management measures would provide a range of options to reuse, recycle, recover and treat waste generated by the long term development. The waste management strategy for the airport would be reviewed in the lead up to the long term development to incorporate new technologies where practicable, such as vacuum collection systems. The implementation of measures to manage waste and thus avoid and mitigate impacts on human health and the environment would be the primary purpose of the waste management strategy.

Despite the increase in waste volume, the overall volume of operational waste would not be significant in the context of the already mature waste management industry in the Sydney region, which has developed to accommodate the needs of many thousands of other commercial waste generators. While the operational long term development would be a major waste generator, the needs of the long term development are expected to be met by the market.

39.7 Hazards and risks

An assessment of hazards and risks was undertaken for the Stage 1 development (see Appendix H, (Volume 4)). The assessment identified key hazards and risks associated with the construction and operation of the proposed airport using a precautionary-based approach, consistent with the provisions of the *Work Health and Safety Act 2011* (Cth) and the *Work Health and Safety Act 2011* (NSW). Owing to the preliminary nature of the design, it was not considered appropriate to conduct the full due diligence assessment required by the above legislation. Such an assessment would be conducted subsequently by others.

Despite the assessment being focused on the Stage 1 development, the range of hazards and risks assessed are also relevant to the long term development.

The potential hazards associated with the operation of the proposed airport were divided into airspace hazards (such as bird and bat strike or adverse meteorology) and ground-based hazards (such as fire or flood). The assessment found that the majority of the identified hazards, and their associated risk, would be satisfactorily resolved through:

- further design and approval processes;
- implementation of industry standards; and
- responsibilities of statutory authorities.

Aspects of the above would be undertaken prior to the long term development, including further bird and bat surveys, obstacle limitation surface surveys and protection, design of flight paths and declaration of protected airspace, CASA aerodrome certification, and various separate approval processes for any additional infrastructure. Some of these matters would be revisited or built upon iteratively up to the long term development, such that risks are adequately controlled at all times.

The operation of a second runway, as part of the long term development, would add substantial complexity to the configuration of Sydney basin airspace and contribute to the expected growth in overall air traffic movements. The development of flight paths associated with the long term development would be subject to an airspace and flight path design process that would include safety as a principal consideration, along with environmental factors such as noise impacts. The future airspace design process for the Stage 1 development is discussed in detail in Chapter 7 (Volume 1). Future airspace design for the long term development would be subject to a similar process, which would include public consultation and further environmental assessment.

A pipeline for the supply of jet fuel would likely be required prior to the long term development in 2063. This would provide more efficient delivery of fuel to the airport site. Any proposal to construct and operate a fuel supply pipeline would be subject to a separate planning and approval process, which would include consideration of risks to people and property. The timing of the pipeline would be based on negotiation between the airport lessee company and the fuel supply industry.

The risk of aircraft accidents was assessed by applying contemporary aircraft manufacturer accident data (2013) to expected air traffic movements for the long term development. Based on the forecast number of air traffic movements in 2063, this equated to an accident rate of one in 30 years. It is noted that this rate reflects 2013 accident data and therefore current aircraft technologies and airspace practices. Actual safety performance of the long term airport development would benefit from improvements to technologies and practices over the coming years and decades.

Overall, it is envisaged that the potential hazards and risks of the future development of the airport could be satisfactorily managed in accordance with design and approval processes, industry standards and statutory responsibilities. Progressive improvements to aircraft technologies and airspace practices are expected to occur up to the long term development and would likely be accompanied by improvements in the safety of people and property.

39.8 Human health

An assessment of the predicted risks to human health associated with the noise, air quality, surface water quality and groundwater impacts of the long term development was undertaken as part of the EIS (see Appendix G (Volume 4)). This health risk assessment builds upon the analysis presented for the Stage 1 development in Chapter 13 (Volume 2a).

The assessment was undertaken in accordance with the Australian Government Guidelines for Health Risk Assessment (enHealth 2012), the National Health and Medical Research Council *Approach to Hazard Assessment for Air Quality* (NHMRC 2006), the World Health Organization (WHO) Guidelines for Community Noise (WHO 2000), the WHO Night Noise Guidelines for Europe (WHO 2009) and the WHO Guidelines for Drinking Water Quality (2011). The health risk assessment uses information about pollutants to estimate a theoretical level of risk to human health at predicted levels of exposure.

Health statistics for Sydney have been used as a baseline in the assessment, with information on the health risks of pollutants being drawn from epidemiological studies. Data on existing pollutant levels come from ambient monitoring stations in Western Sydney operated by the NSW Office of Environment and Heritage (OEH) and the NSW Environment Protection Authority (EPA).

The risk assessment process comprises five stages: issue identification, hazard (or toxicity) assessment, exposure assessment, risk characterisation and uncertainty assessment. The issue identification stage determined that the primary risks to human health from the proposed airport were exposure to excessive noise, air emissions or pollution in surface and groundwater.

The health risk assessment is based upon the findings of the local and regional air quality, noise and water technical studies undertaken as part of the preparation of the EIS. The potential health effects of local air quality, including emissions from aircraft overflights, ground based activity and traffic associated with the proposed airport are key considerations in the assessment.

39.8.1 Assessment of impacts during operation

39.8.1.1 Air quality

The air quality component of the health risk assessment relies on the outputs of a local air quality assessment (see Appendix F1 (Volume 4)) and a regional air quality assessment (see Appendix F2 (Volume 4)). The findings of these assessments for the long term development are presented in Chapter 32. The local air quality assessment quantifies primary emissions from the proposed airport including particulate matter, nitrogen dioxide, sulfur dioxide and carbon monoxide. The regional air quality assessment primarily focuses on the formation of ozone across the Sydney basin. Further information on the methodologies and limitations of the local and regional air quality assessments are included in Appendix F1 and Appendix F2 (Volume 4) respectively.

To assess the potential air quality health risk, several residential locations were identified that represented the communities that would be most affected by air emissions from airport operations and associated road traffic. The locations used are Bringelly, Luddenham, Badgerys Creek, Greendale, Rossmore, Mount Vernon, Wallacia, Mulgoa and Kemps Creek. The total population covered by these areas is around 14,000 people.

It is important to note that the air quality modelling and thus the health risk assessment includes predicted increases in emissions from background traffic due to the broader urbanisation of Western Sydney. Therefore, the risks presented are not solely attributable to emissions from the operation of the long term development.

The analysis presented in this section should be viewed in the context of overall health in the Sydney basin. In 2006 there was a Parliamentary Inquiry into the health effects of air pollution in Sydney. Evidence provided by NSW Health at that time estimated that in Sydney there were between 600 and 1400 deaths per year due to air pollution in the Sydney basin (NSW Parliament, 2006). The focus of this report was on air pollution generally, although most of these deaths were attributed to PM_{2.5}. A more recent assessment conducted as part of a cost benefit analysis for the review of the *Fuel Quality Standards Act 2000* (Marsden Jacobs, 2016) estimated that in 2015 nitrogen dioxide in Sydney was responsible for 330 additional deaths per year and an additional 336 and 371 hospital admissions for respiratory disease and cardiovascular disease, respectively, in people over 65 years of age. The incremental increase in air pollution predicted for operation of the long term development is very small in this context.

Particulates

Annual average and 24-hour particulate matter have been modelled as part of the air quality assessment for the long term development. Particulate matter is typically quantified as less than 10 micrometres and 2.5 micrometres in aerodynamic diameter (PM₁₀ and PM_{2.5} respectively).

The health risks predicted for the long term development for both PM₁₀ and PM_{2.5} are higher than those predicted for the proposed Stage 1 development. The highest predicted risk associated with PM₁₀ would be for all-cause mortality due to long term exposure with between one additional death per 100 years and nine additional deaths per 100 years. Similarly, the highest predicted risk for PM_{2.5} would be for all-cause mortality due to long term exposure with between one additional death per 100 years and eight additional deaths per 100 years. All other risks are lower than the risk predicted for these outcomes. For both PM₁₀ and PM_{2.5} the highest predicted impacts are at Rossmore, Bringelly and Kemps Creek.

Nitrogen dioxide

The health assessment found that the risk from exposure to nitrogen dioxide is predicted to be higher than the risk predicted for the Stage 1 development. It is accepted that there is no threshold for nitrogen dioxide below which adverse health effects are not observed.

The highest predicted risk for nitrogen dioxide would be for all-cause mortality due to long term exposure with a maximum risk of 1.6 additional deaths per year due to the long term development. The highest risks are predicted at Luddenham, Bringelly, Kemps Creek, Mulgoa and Rossmore. When road traffic is excluded from the calculations (road traffic comprises approximately 32 per cent of NO₂ emissions in 2063), the maximum level of additional deaths reduces to 1.2 per year.

As noted earlier, the incremental increase in predicted health risks for the long term development are very small in the context of existing air pollution and health outcomes in the Sydney region.

Ozone

The regional air quality assessment (see Appendix F2 (Volume 4)) predicted increased ozone concentrations for a number of days during the long term development. Increases in ozone would tend to occur downwind of the airport site which, on most days, is to the south and south-west. Decreases in daily maximum ozone concentrations attributable to suppression by emissions of nitrogen oxides could also occur in the vicinity of the airport site and are from airport operations.

There is general agreement by international agencies including the World Health Organization and the US Environmental Protection Agency that acceptable risk levels fall between one in a million and 0.5 in 100,000. For the long term development, the highest predicted risks from ozone are between five in one million for respiratory mortality and 4.5 in 100,000 for emergency department attendances for asthma in children.

Implementation of the mitigation measures outlined in Chapter 28 (Volume 2b) relating to air quality impacts will lead to improvements in ozone precursors and reduce the risk posed by ozone on peak ozone days. It should be noted that a large component of predicted ozone concentrations, and therefore health risk, is attributable to background ozone concentrations from sources other than the proposed airport such as background industrial activities and road traffic.

39.8.1.2 Noise

Sleep disturbance

Sleep disturbance impacts are quantified with the metric of electroencephalography (EEG) awakenings as well as full awakenings. An EEG awakening involves an increased level of brain activity but not an awakened state in the usual sense. For context, individuals typically exhibit about 24 EEG awakenings per eight hours of sleep (European Environment Agency 2010).

The operation of the long term development is predicted to increase this number of EEG awakenings and full awakenings for a number of communities around the airport site. The number of additional EEG awakenings due to aircraft overflight noise is predicted in the range of zero to 110 additional EEG awakenings per person per year, depending on the operating scenario. This would represent around a one per cent increase against the normal conditions of around 24 EEG awakenings per night. Of the communities assessed, Luddenham and Greendale were predicted to experience the highest increase in EEG awakenings due to aircraft overflight noise.

The number of full awakenings due to aircraft overflight noise would be significantly lower than the predicted EEG awakenings. Aircraft overflight noise associated with the long term development is predicted to result in between zero and 10 full awakenings per person per year, depending on the operating mode. The highest increase in full awakenings would occur at Luddenham, Greendale and Horsley Park each with an additional 10 full awakenings per person per year under the preferred operating strategy.

Ground-based operations noise at the proposed airport would have the potential to cause further EEG awakenings at communities close to the airport site. The number of additional EEG awakenings due to ground-based operations noise is predicted in the range of zero to 150 additional EEG awakenings per person per year in the long term. The highest increase in EEG awakenings due to ground-based operations noise is predicted to be in Luddenham with a 150 additional EEG awakenings per person per year.

As with aircraft overflight noise, the number of full awakenings associated with ground-based noise is predicted to be significantly lower than the number of EEG awakenings for the long term development. Full awakenings associated with ground-based noise would be between zero and four additional full awakenings per person per year.

The highest increase would be in Luddenham with an additional four full awakenings per person per year, followed by Greendale with an additional three full awakenings and Kemps Creek with an additional two full awakenings. All other communities assessed are not predicted to have any increase in full awakenings associated with ground-based noise in the long term.

Cardiovascular effects


The WHO Night Noise Guidelines for Europe (WHO 2009) identifies the no observed adverse effects level (NOAEL) for increases for myocardial infarction (heart attacks) is 55 dB $L_{\text{night, outside}}$. For all receptors assessed, for both overflight and ground-based noise, the $L_{\text{night, outside}}$ predicted levels were below 55 dB (see Appendix G (Volume 4) for more detail). This was observed for all years assessed and all operating modes. On the basis of these results, it can be concluded that the aircraft overflight noise and ground-based noise would not lead to any increased risk in myocardial infarction in nearby communities.

Learning and cognitive development in children

Risks to cognitive development were assessed based on the WHO Community Noise Guidelines (WHO 1999) and enHealth Guidelines (enHealth 2012). The assessment calculates a hazard quotient derived from noise exposure, for both outside and inside noise levels.

In terms of learning and cognitive development in children, hazard quotients less than one are considered to be an acceptable level of risk (enHealth 2012). A hazard quotient greater than one does not mean that there will be an impact on children's learning and cognitive development. Rather, it means there is an increased risk, albeit very low. Noise mitigation measures recommended in Chapter 31 would reduce this potential risk.

The assessment found that for aircraft overflight noise associated with the long term development all hazard quotients for outside noise and most hazard quotients for indoor noise are less than one, indicating that aircraft overflight noise from each of the modelled operating strategies generally do not pose an unacceptable risk. In some cases, there are marginal exceedances of one when considering indoor noise. These marginal exceedances are predicted at particular institutions in places such as Kemps Creek, Horsley Park and Luddenham.



The assessment found that the risks resulting from airport ground-based operations noise were more substantial than for aircraft overflights. In relation to ground-based operations noise, the assessment found that only Luddenham Primary School would experience a hazard quotient of greater than one, being for indoor noise. All other educational institutions would not experience a hazard quotient greater than one for indoor or outdoor noise. If, based on operational experience, the predicted noise levels are realised, mitigation measures should be implemented to reduce this risk to within acceptable levels.


39.8.1.3 Groundwater

Based on available information relating to the types of activities that will be conducted during the long term operation of the proposed airport, there is considered to be minor potential for risks to the environmental values of groundwater in the alluvial and Bringelly Shale aquifers.

The airport site has historically been used for a wide range of agricultural, industrial, commercial and rural-residential activities that generate various potential contaminants in soil and groundwater. For this reason, it is important that baseline groundwater data are collected, including for all potential contaminants that may be already present to enable identification of the current baseline conditions and from which to monitor future performance of the long term development.

39.8.1.4 Surface water

Chapter 13 (Volume 2a) provides a qualitative evaluation of the operation activities and whether there would be an impact to surface water bodies in and around the airport site, including rainwater tanks on private property. This includes an assessment of accidental spills of stored chemicals or fuels, release of stored groundwater, aircraft emissions and emergency fuel jettisoning. As with the Stage 1 development, activities associated with the operation of the long term development are considered to have a low risk of impacting on the environmental values of nearby surface water.



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